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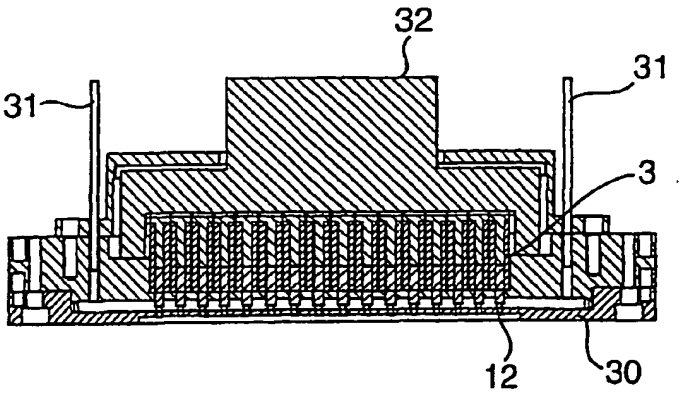
[Continued on next page]

(54) Title: SOLENOID VALVE FOR A DROP ON DEMAND INK JET PRINTER



(57) Abstract: The invention relates to a solenoid valve made using certain materials which is capable of operation at high frequencies and which can be made as a compact unit. The plunger (1)is of a unitary construction and is made of an electromagnetically soft material having a saturation flux density greater than 1.4 Teslar. Furthermore the pluger (1) has a daimeter of 3mm or less and a length or diameter ratio of less than 15:1 The invention also relates to method for operating a drop on demand ink jet printer incorporating such a valve.

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25 March 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

Ir nal Application No
PCT/GB 03/03024

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16K31/06 G06K15/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16K G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 641 148 A (PENEA JAMES A ET AL) 24 June 1997 (1997-06-24) column 2, line 60 -column 3, line 52; figure 3	1,12,26, 27,45
A	WO 98 56585 A (JETLINE AB ;MIELKE ULF (SE)) 17 December 1998 (1998-12-17) cited in the application abstract	1,12,26, 27,45
A	WO 94 08794 A (WILLETT INT LTD ;WALTON ROBERT LIONEL (GB)) 28 April 1994 (1994-04-28) page 10, paragraph 3 -page 11, last paragraph; figure 1	1,12,26, 27,45

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 January 2004	02 FEB 2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Christensen, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/03024

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 985 715 A (CYPHERT DAVID L ET AL) 15 January 1991 (1991-01-15) abstract	1,12,15, 26,27
X	EP 0 709 192 A (CANON KK) 1 May 1996 (1996-05-01)	28-33,37
A	column 6, line 31 -column 8, line 38; figures 1-3	34-36, 38-44

INTERNATIONAL SEARCH REPORT

...ternational application No.
PCT/GB 03/03024

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-27, 37-44 (when depending on claim 27),45

The technical features of claim 1:

A valve mechanism for controlling flow comprising:

a1) a plunger reciprocating between a rest position and an operative position

a2) an electrical coil generating a magnetic field to operate the plunger depending on the current passing through the coil

a3) a valve chamber with an outlet bore in communication with a nozzle outlet into which the distal end of the plunger extends to open or close a fluid flow path

a4) the plunger is unitary and made of electromagnetically soft material with a saturation flux density grater than 1.4 Teslar

a5) the plunger has a diameter of 3 mm or less and a length to diameter ratio of less than 15:1

The independent claims 12,26 and 45 correspond to claim 1

2. Claims: 28-36, 37-44 (when depending on claim 28),

The technical features of claim 28:

A drop on demand printer comprising:

b1) a nozzle to form a printer dot on a substrate

a1) a plunger reciprocating between a rest position and an operative position

a2) an electrical coil generating a magnetic field to operate the plunger depending on the current passing through the coil

b2) a computer in operative combination with the printer

b3) a mechanism for observing the ejected droplet

b4) computer detect difference between observed droplet and desired droplet and apply correction to the current applied to the coil of the valve to regulate the flow to maintain the desired observed droplet.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

The independent claims 32,34 and 36 correspond to claim 28

INTERNATIONAL SEARCH REPORT

Information on patent family members

In nal Application No
PCT/GB 03/03024

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5641148	A	24-06-1997	NONE		
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